Microfluidic Isolation of Endothelial Progenitor Cells for Vascular Tissue Engineering

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Abstract

Endothelial progenitor cells (EPCs), which are naturally present in circulating blood, are an especially interesting cell type because they have the ability to repair damaged blood vessels. EPCs have been utilized as precursors in the in vitro cultivation of vascular grafts. The conventional technique of isolating EPCs involves centrifugation followed by pre-plating. As tissue engineering and cell-based therapeutics begin the transition from the laboratory to clinical applications, the availability of robust and simple cell isolation techniques becomes significant. The principal goal of this work is to create microfluidic cell separations systems to rapidly and efficiently isolate EPCs for use in vascular tissue engineering applications. The first goal is create a microfluidic platform that can selectively capture and release EPCs from complex cell suspensions such as blood. This is done by developing a sacrificial alginate layer that can be conjugated with specific capture antibodies that bind to EPCs with a high degree of specificity. The gel is further optimized to reduce the number of non-target cells adhered while maximizing the number of target cells captured. These 'capture chips' can then be applied in series with each chip containing a different capture ligand. This enables the separation of cell types that share common markers. Applying these gels as surface coatings within a microfluidic channel provides the ability to isolate EPCs from untreated whole blood in a single pass. This isolation will enable these cells to be expanded to sufficient numbers for tissue engineering studies. Cells will be characterized and compared with EPCs isolated using the current technique of pre-plating. Finally consideration will be given to transitioning this technique into a form that can be easily adopted in a point of care clinical setting. This will be achieved in part by investigating the ability of the coating to be applied to a variety of commercially available substrates. Ultimately this work will develop a technique for rapidly isolating cells in a convenient manner to quickly create stocks of cells for use in vascular tissue engineering.